NASA STTR 2011 Phase I Solicitation

T10 Rocket Propulsion/Energy Conservation

NASA's Stennis Space Center (SSC) seeks advanced technologies to support its testing of rocket engines including innovative approaches for component technologies, advanced rocket facility environment and health monitoring, new materials for rocket plume deflection and technologies for propellant conservation. Technologies are also sought to improve the Center's energy conservation and sustainability.

Subtopics

T10.01 Test Area Technologies

Lead Center: SSC

Innovative Component Technologies

The focus of this topic is the development of innovative rocket test facility components (e.g., valves, flowmeters, actuators, tanks, etc.) for ultra high pressure (>8000 psi), high flow rate (>100 lbm/sec), and cryogenic environments. Robust and reliable component designs which are oxygen compatible and can operate efficiently in high vibro-acoustic, transient environments are being sought. Components which can also provide coupled high-speed (kHz-MHz) measurement and control of rocket propellant feed systems with minimum induced system losses are desirable. Proposals of innovative valve design concepts which will provide true linear performance for installed configurations and/or provide dynamically adjustable valve trimming are encouraged. Expected TRL at end of Phase I is 2, and at the end of Phase II is 4.

Advanced Rocket Facility Environment and Health Monitoring

Development of practical, industrial-grade, advanced flow/thermal diagnostics and smart sensors to monitor the near field environment (thermal, acoustic, emission) that a rocket test facility is exposed to during an engine/stage testing is requested. Examples of advanced rocket test environment diagnostics would include high-speed robust scanning or visualization of rocket exhaust plumes for simultaneous heat flux, species/temperature and/or near-field acoustics. In addition to the rocket test induced environments, infrastructure health monitoring and management for test facilities and for widely distributed support systems (WDSS) such as gas distribution and cooling water is needed. Capabilities being sought for WDSS include remote monitoring of vacuum lines, gas leaks, and fire, where the use of wireless technologies in order to eliminate running miles of power and data wires would be beneficial in this application. The proposed innovative systems must lead to improved safety and reduced test

costs by allowing real-time analysis of data, information, and knowledge through efficient interfaces to enable integrated awareness of the system condition by users. Need for improved technologies are mid-term, and highly desirable. Expected TRL at end of Phase I is 3, and at the end of Phase II is 6.

Development of New Materials for Rocket Plume Deflection

Refractory materials are commonly used to provide thermal protection of rocket plume deflectors on test facilities and launch pads. Advancement of refractory materials or development of new materials for the requirement of minimizing erosion (1500 BTU/ft^2/sec) and shear/normal loads caused by the direct impingement of rocket exhausts is desired. Unlike launch facilities, test facilities are exposed to the plume environments for long durations (on the order of minutes) making the material requirements for minimum erosion even more stringent. The newly proposed material would need to be competitive to the material, installation and repair costs of current commercial grade high-temperature refractory materials. Also, the material development proposal should demonstrate the performance of the material in dynamically similar environments as would be present on the rocket test stand. Expected TRL at end of Phase I is 2, and at the end of Phase II is 4.

Technologies for Propellant Conservation

The objective is to minimize usage of costly gases (helium and hydrogen) through devices that can recover/recycle efflux from cryogenic test facilities (currently no recovery is done). This could include technologies such as real time gas sampling/contamination monitoring system for propellant and purge systems that could also help minimize use of non renewable resources such as Helium, or Helium reclamation carts for recapture of inert/purges. Expected TRL at end of Phase I is 3, and at the end of Phase II is 6.

T10.02 Energy Conservation and Sustainability

Lead Center: SSC

John C Stennis Space Center (SSC) is a large rocket propulsion test facility located in southern Mississippi close to the Louisiana state line. Energy consumption is very large to sustain the static engine testing and supporting facilities. In an effort to conserve on energy and enhance the sustainability of these and other SSC facilities, interest exists in pursing innovative approaches to energy savings, water efficiency, CO_2 emission reductions, improved environmental quality. This includes the use of green technologies that support LEED certification. Technologies which have potential to support multiple centers or programs are highly desirable. The following listing includes some specific areas of interests for supporting SSC's energy conservation goals:

Innovative Energy Conservation Technologies

SSC is interested in innovative technologies for reducing energy consumption and improving building sustainability through the use of alternative energy sources including of geothermal, natural gas and solar. Those using renewable sources of energy are highly desired. The goal is to reduce overall energy consumption and the Center's carbon footprint. Energy conservation technologies must also be cost effective to implement and maintain. Concepts will be evaluated based on their potential efficiency, ease of implementation and maintenance, and flexibility of applications (including, but not limited to, HVAC, preheating hot water heaters, and other means of extracting energy), as well as, applicability to the Center's mission. Proposals will also be evaluated based on the

maturity level to which the technology will be developed and innovative techniques. Expected TRL at end of Phase I is 2, and at the end of Phase II is 6.

Innovative Facility Sustainability Technologies

SSC is interested in innovative technologies for enhancing building and facility sustainability. The goal is to reduce the life-cycle costs for sustainability facilities and testing through the use of green or renewable products. Specific areas of interest include technologies which help sustain a healthy workplace including mold spore filtration, self-decontamination and air purification. Concepts will be evaluated on the innovativeness, maturity level of the technology and long-term viability of the concept. Expected TRL at end of Phase I is 2, and at the end of Phase II is 6.

Innovative Lighting Technology

Stennis Space Center is interested in developing innovative technologies, systems, or methodologies that will reduce the energy consumption and heat generation from facility lighting while maintaining the desired level of illumination for safety and effective work environments. SSC is interested in innovative lighting technologies for the test areas, office areas and parking lots. Innovative approaches for bringing natural lighting through skylights or other receptors are also of interest. These lighting technologies will need to reduce energy consumption while maintaining a comfortable and safe working environment. Technologies can be for replacement a technology or optimization of current facility lighting system. SSC is particularly interested in replacing costly lighting in the test area (test stands, hydrogen/oxygen environments, hazardous and potentially corrosive environments). The lighting should be in compliance with IESNA RP 7-01, Practice for Industrial Lighting. Proposals will be evaluated based on the maturity level to which the technology will be developed and innovative techniques that will provide a reasonable life expectancy. Proposals will also be evaluated on implementation strategy and ease of maintenance. Expected TRL at end of Phase I is 2, and at the end of Phase II is 6.

Innovative Solar Technology

Reduction in energy consumption and subsequent energy cost is a high priority at SSC. SSC is interested in developing new technologies for the efficient and effective use of photovoltaic/solar cell to reduce energy costs. Major issues in the development and use of solar panel include efficient system design and installation as well as effective maintenance. Innovative approaches and tools to facilitate the design of efficient solar cell systems, effective application of solar cells systems for building rooftops or a separate field area of solar cells are desired as well as innovative approaches to the monitor the health of the system and maintenance methods to insure the most effective and efficient operations of the system in an environment with high humidity, extensive rain showers, high pollen counts, rapid mold and fungal growth, etc. Expected TRL at end of Phase I is 2, and at the end of Phase II is 6.